Anatomy of the COVID-19 Pandemic: An Epidemiologists View Point

Tarundeep Singh[1] and **Sathiabalan Murugan[1]**

The Coronavirus Disease 2019 (COVID-19) pandemic is a highly contagious disease caused by a novel, enveloped single-stranded ribonucleic acid virus named as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Globally, it affected more than 200 countries with nearly 5 million confirmed cases and 0.3 million deaths as of 2020, 22 May.[1] The median incubation period of the virus is about 3–9 days, with a range between 0 and 24 days.[2] The mean serial interval is about 3–8 days, presenting sooner than the end of incubation. This suggests that one becomes contagious before symptoms present (about 2.5 days earlier from the start of symptoms). About 44% of transmission is estimated to occur before symptoms arise.[3]

Whether a disease spreads or dies out within a population depends on the basic reproduction number (R0) which is the number of new cases of disease produced by a single case.

1. If R0 > 1, the disease spreads, i.e., each case gives rise to more than one new case. The larger this number, more rapid the spread.
2. If R0 = 1, the disease becomes endemic and stable in a population.
3. If R0 < 1, the disease slowly dies out.

The R0 for COVID-19 is estimated to be 2.2.[4]

The R0 can be reduced to <1 in two ways:

1. Interrupting chain of transmission. For example, we kill mosquitoes to interrupt chain of transmission in malaria and dengue.

2. Herd immunity. When a significant number of people get infected, there are lesser susceptible individuals available to be infected. Hence, there is a herd of immune people which protects the susceptible. This can be achieved through the following two ways:
   1. Vaccination (unlikely to be available in the near future for COVID-19)
   2. Natural infection.

The proportion of population needed to have sufficient herd immunity for a particular disease (whether through vaccine or infection) is by and large the same across most population groups. Percentage of population needed to be infected for herd immunity can be derived by using the formula [1 − (1/ R0)] × 100. For COVID-19, it is believed to be around 60%–70% for developing herd immunity in the community.

Most of the transmission of COVID-19 is through asymptomatic persons (believed to be approximately 80% for COVID-19). These asymptomatic will not be detected or isolated and shall continue to spread the infection.[5] Further, morbidity and mortality because of a disease depend on many factors, malnutrition, status of health care services, and age composition of the population being the major ones for COVID-19.

Deducing from the above, the COVID-19 infection in India is likely to show a downward trend only after sufficient herd immunity is reached and almost 60%–70% of Indians are infected. This might result in a lot of mortality and morbidity as the burden of malnutrition in India is high and the state of public health services is poor. However, India does have relatively younger population which may result in lower mortality. Hence, the prediction of the extent of morbidity and mortality is complex.

Different countries have adopted different strategies to tackle the pandemic caused by SARS-CoV-2. Countries such as South Korea and Japan have opted to go for extensive testing, contact tracing, and strict isolation, and have been able to contain the infection and damage to the economy. Countries such as the USA, Italy, and the UK have adopted the strategy of widespread testing and adopted isolation and partial lockdown only when the number of cases became very high. However, India chose the strategy of total lockdown which slowed down the rate of spread of the infection, allowing us time to make arrangements, accumulate supplies, and draft management plans. This time was reasonably well utilized.

However, lockdown can only break the chain of transmission when it is very strictly enforced with no person being allowed out of home at all for any reason for at least

[1] Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research, Chandigarh, India
Corresponding author:
Tarundeep Singh, Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India.
E-mail: Tarundeep.singh@gmail.com

twice the incubation period, that is, 28 days, and accompanied by widespread testing, meticulous contact tracing, and isolation. Prolonged and strict lockdown is not possible in a resource-constrained democracy like India where a large proportion of the population earns a daily living with little or no reserves. Hence, as India emerges from lockdown, the strategy of extensive targeted testing with isolation needs to be followed to prevent sudden overwhelming of the health care services and the resultant increased mortality. At the same time, the availability of food grains and cash needs to be ensured to the daily wagers who are quarantined or isolated, so that there is no violation because of desperation to meet the daily needs.

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Both the authors contributed equally to the manuscript.

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ORCID iD

Tarundeep Singh (iD) https://orcid.org/0000-0002-3674-8227

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